References

Balph, M. H., L. C. Stoddart and D. F. Balph. 1977. *A simple technique for analyzing bird transect counts*. Auk 94:606-607.

Brown, C.J., E.D. Smith, J.M. Siperek, N.A. Villa, H.H. Reading, and J.P. Finn. 1983. *Thomes-Newville Unit fish and wildlife evaluation*. California Department of Fish and Game. 207 p.

Brown, C.J., J.R. Garcia, and A. Woesner. 1987. *Final report on Reconnaissance level studies at the Dippingvat and Shoenfield reservoir site*. California Department of Fish and Game. 89 p.

Brown, R.D. and E. Rich. 1961. Geologic Map of the Lodoga Quadrange, Glenn and Colusa Counties, California. U.S. Geological Survey, Oil and Gas Investigation Map OM-210.

California Department of Fish and Game. 1983. *Thomes-Newville Unit Fish and Wildlife Evaluation-A Status Report*. 207pp.

_____. 1980. "Engineering Geology of the Red Bank Project, Tehama County, California."

_____. 1978.*West Sacramento Valley Fault and Seismicity Study, Glenn Complex, Colusa Reservoir, Berryessa Enlargement*. Division of Design and Construction, Project Geology Branch, 43 pp.

Chuber, S. 1961. *Late Mesozoic Stratigraphy of the Elk Creek-Fruto Area, Glenn County, California*. PhD. Thesis, Stanford University. 115 pp.

Earth Sciences Associates. 1980. *Seismic and Fault Activity Study of the Proposed Glenn Reservoir Complex*. Prepared for DWR.

Emlen, J. T. 1971. *Population densities of birds derived from transect counts*. Auk 88: 323-342.

Helley, E.J. and D.S. Harwood. 1985. Geologic Map of the Late Cenozoic Deposits of the Sacramento Valley and Northern Sierra Foothills, California. U.S. Geological Survey Map MF 1790.

Kirby, J.M. 1943. *"Sites Region"*. California Division of Mines Bulletin 118. pp. 606-608.

Moyle, P.B. *Inland Fishes of California*. University of California Press, Berkeley and Los Angeles, CA. 1976. pp. 162-210.

Skinner, M. and B. Pavlik. 1994. *California Native Plant Inventory of Rare and Endangered Vascular Plants of California*. Special publication No. 1. Fifth edition. California Native Plant Society.

U.S. Bureau of Reclamation. 1969 and 1980. Series of memos for the West Sacramento Canal Unit on engineering geology of Sites Reservoir Project.

U.S. Geological Survey. 1996. *Database of Potential Sources for Earthquakes Larger than Magnitude 6 in Northern California*. Open File Report 96-705. Available on the Internet.

William Lettis and Associates. October 1997. *Seismotectonic Evaluation - Stony Gorge and East Park Dams of the Orland Project and Monticello Dam of the Solano Project.* Prepared for the U.S. Bureau of Reclamation. 145 pp. With plates and Appendices.

_____. 2000. *Phase II Fault and Seismic Hazard Investigation, Basic Data Report for the 1999 Field Season*.

Wong, I.G., et. al. *Contemporary Seismicity and Tectonics of the Northern and Central Coast Ranges-Sierran Block Bondary Zone, California*. Journal Geo. Vol. 93, Nos. 87. pp 7,813-7,833. July 10, 1988.

Ziener, D.C., W. F. Laudenslayer Jr., K.E. Mayer, and M. White eds. 1990. *California's wildlife Volume II: Birds*. State of California, The Resources Agency, Department of Fish and Game, Sacramento, CA. 732p

Glossary

A

active storage capacity the usable reservoir capacity available for seasonal or cyclic water storage. It is gross reservoir capacity minus inactive storage capacity.

afterbay a reservoir that regulates fluctuating discharges from a hydroelectric power plant or a pumping plant.

agricultural drainage (1) the process of directing excess water away from root zones by natural or artificial means, such as by using a system of drains placed below ground surface level; also called subsurface drainage; (2) the water drained away from irrigated farmland.

alluvial pertaining to or composed of alluvium

alluvium unconsolidated soil strata deposited by flowing water.

anadromous fish that spend a part of their life cycle in the sea and return to freshwater streams to spawn.

aquifer a geologic formation that stores water and yields significant quantities of water to wells or springs.

average annual runoff for a specified area is the average value of annual runoff volume calculated for a selected period of record, at a specified location, such as a dam or stream gage.

B

bedload the part of the sediment in a stream that is moved on or immediately abouve the stream bed usually consisting of boulders, pebbles, and gravel.

biota living organisms of a region, as in a stream or other body of water.

brackish water water containing dissolved minerals in amounts that exceed normally acceptable standards for municipal, domestic, and irrigation uses. Considerably less saline than sea water.

brooding water used by nesting waterfowl to rear their young.

C

California Species of Special Concern species designated by the California Department of Fish and Game as having declining population levels, limited ranges, and/or continuing threats have made them vulnerable to extinction. The purpose of this designation is to halt or reverse their decline by calling attention to their plight and addressing issues of concern early enough to secure their long term viability.

candidate species species that have been petitioned to be listed as threatened or endangered based upon current information and data available. These species are under review and investigation through research for formal listing as threatened or endangered.

chaparral a major vegetation type in California characterized by dense evergreen shrubs with thick, hardened leaves.

colluvial overburden colluvium that is laying on hard rock which must be removed for construction to take place.

colluvium a general term applies to heterogeneous material of loose soil or rock fragments that is deposited at the base of a hill by rainwash or downhill creep.

compressive strengths the amount of pressure that can be applied to a rock, under certain conditions, before the rock breaks or is crushed.

conglomerate a sedimentary rock composed of rounded to subangular fragments larger than sand, surrounded by sand, silt, or clay. These fragments are usually cemented together.

conglomerate clasts the rock fragments that make up the coarse-grained portion of a conglomerate.

conjunctive use the operation of a groundwater basin in combination with a surface water storage and conveyance system. Water is stored in the groundwater basin for later use by intentionally recharging the basin during years of above-average water supply.

cretaceous a geologic period that covers the geologic time scale from about 65 to 144 million years ago.

D

deep percolation percolation of (irrigation) water through the ground into the groundwater.

dissolved organic compounds carbon-based substances dissolved in water.

dissolved oxygen (**DO**) the amount of oxygen dissolved in water or wastewater, usually expressed in milligrams per liter, parts per million, or percent of saturation.

drainage area the area of land from which water drains into a river; for example, the Sacramento River Basin, in which all land area drains into the Sacramento River. Also called watershed or river basin.

DFG harvest species species managed by the Department of Fish and Game for public hunting opportunities. Species include but are not limited to deer, ducks, bear, and pigs.

E

electrical conductivity a measurement of how easily electricity flows through water. This correlates with the Total Dissolved Solids in water. The higher the TDS, the more easily electricity flows through the water, the higher the electrical conductivity.

emergent wetlands wetlands containing erect, rooted vegetation such as tules (not including mosses and lichens).

endangered species a species at high risk to extinction in the wild in the near future.

environmental water the water for wetlands, for the instream flow in a major river or in the Bay-Delta, or for a designated wild and scenic river

ephemeral a stream, pool, or lake that occurs for only the "wet" portion of the year. These bodies of water disappear during the summer months.

eutrophic said of a body of water characterized by a high level of plant nutrients, with correspondingly high primary productivity.

F

fault gouge soft, uncemented, pulverized clayey material filling or partly filling a fault zone or found along a fault.

fluvial of or pertaining to a river or rivers.

forebay a reservoir at the intake of a pumping plant or power plant to stabilize water levels; also a storage basin for regulating water for percolation into groundwater basins.

fry a recently hatched fish.

G

Geologic province a large region characterized by similar geologic history and rocks.

gradient the steepness of the slope of the land surface or river

gross reservoir capacity the total storage capacity available in a reservoir for all purposes, from the streambed to the normal maximum operating level. Includes dead (or inactive) storage, but excludes surcharge (water temporarily stored above the elevation of the top of the spillway).

groundwater water that occurs beneath the land surface and fills the pore spaces of the alluvium, soil, or rock formation in which it is situated.

groundwater area an area where because of the nature of the geologic material, groundwater is found. Unlike a groundwater basin, the boundaries of a groundwater area are less definitive.

groundwater basin a groundwater reservoir, defined by an overlying land surface and the underlying aquifers that contain water stored in the reservoir. In some cases, the boundaries of successively deeper aquifers may differ and make it difficult to define the limits of the basin.

groundwater recharge the natural or intentional infiltration of surface water into the zone of saturation (i.e., into groundwater).

groundwater table the upper surface of the zone of saturation, in an unconfined aquifer.

H

Habitat Evaluation Procedure a computerized method used to inventory habitats and assess impacts that combines habitat quality with habitat area to calculate Habitat Units. The Habitat Units are sensitive to changes in both amount and quality of habitat. The project consists of quantitative information for each species or suite of species evaluated.

Habitat Suitability Index Model species models that are used for habitat-based evaluation techniques.

Holocene a geologic epoch in the Quaternary that ranges from now to 10,000 years ago.

hydrologic basin the drainage area upstream from a given point on a stream.

I

instream use use of water within its natural watercourse. For example, the use of water for navigation, recreation, fish and wildlife, aesthetics, and scenic enjoyment.

irrigation return flow applied water that is not transpired, evaporated, or infiltrated into a groundwater basin but that returns to a surface water body.

J

jurassic a geologic period that covers the geologic time scale from 144 to 208 million years ago.

L

land subsidence the lowering of the natural land surface due to groundwater (or oil and gas) extraction.

lenticular a sedimentary deposit that is lense-shaped

lineament a linear feature on the earth's surface that is believed to reflect the earth's structure (i.e. fractures, faults, aligned volcanoes, and straight stream courses).

M

maximum contaminant level (MCL) the highest drinking water contaminant concentration allowed under federal and State Safe Drinking Water Act regulations.

maximum storage the maximum amount of water that can be stored in a reservoir

mean sea level the average height of the surface of the sea for all stages of the tide over a long period of time. Mean sea level is used as a datum plane for the measurements of elevations and depths.

metavolcanic an informal term of volcanic rocks that shown evidence of having been subjected to pressure and temperature after their deposition from volcanic activity.

ML

multipurpose project a project, usually a reservoir, designed to serve more than one purpose, and whose costs are normally allocated among the different functions it provides. For example, a project that provides water supply, flood control, and generates hydroelectricity.

N

National Pollutant Discharge Elimination System (**NPDES**) a provision of Section 402 of the federal Clean Water Act that established a permitting system for discharges of waste materials to water courses.

nonpoint source waste water discharge other than from point sources. See also point source.

normal pool elevation (or reservoir) the highest elevation at which reservoir water is normally stored. This is usually the spillway crest elevation.

nomlaki tuff member a tuff unit in the Pliocene rock units that has been given a formal name. It has been identified throughout the Sacramento Valley.

O

offstream storage a reservoir on a small stream that does not significantly contribute to the water supply of the reservoir. The water supply for the reservoir is diverted from a nearby river via one or more conveyance facilities to the reservoir.

P

pathogens viruses, bacteria, or other organisms that cause disease.

pediment **a broad, gently sloping surface caused by erosion.**

permeability the capability of soil or other geologic formations to transmit water.

phytoplankton minute plants, such as algae, that live suspended in bodies of water.

pleistocene a geologic epoch that covers the geologic time scale from 10,000 to 1.6 million years ago.

pliocene a geologic epoch that covers the geologic time scale from 1.6 to 5.3 million years ago.

point source a specific site from which wastewater or polluted water is discharged into a water body.

pollution (**of water**) the alteration of the physical, chemical, or biological properties of water by the introduction of any substance into water that adversely affects any beneficial use of water.

project yield the water supply attributed to all features of a project, including integrated operation of units that could be operated individually.

pumice a rock composed of volcanic ash. Its light weight many times will allow it to float on water.

pump lift the distance between the groundwater table and the overlying land surface.

pumped storage project a hydroelectric powerplant and reservoir system using an arrangement whereby water released for generating energy during peak load periods is stored and pumped back into the upper reservoir, usually during periods of reduced power demand.

pump-generating plant a plant which can either pump water or generate electricity, depending on the direction of water flow.

Q

quaternary a geologic period that covers the geologic time scale from now to 1.6 million years ago.

R

recent a geologic epoch in the Quaternary that ranges from now to 10,000 years ago. This epoch is sometimes referred to as the holocene.

recharge basin a surface facility constructed to infiltrate surface water into a groundwater basin.

recycled water urban wastewater that becomes suitable, as a result of treatment, for a specific beneficial use. Also called reclaimed water. See also water recycling.

return flow the portion of withdrawn water not consumed by evapotranspiration or system losses which returns to its source or to another body of water.

riparian located on the banks of a stream or other body of water. Riparian water rights are rights held by landowners adjacent to a natural waterbody.

runoff the volume of surface flow from an area.

S

salinity generally, the concentration of mineral salts dissolved in water. Salinity may be expressed in terms of a concentration or as an electrical conductivity. When describing salinity influenced by seawater, salinity often refers to the concentration of chlorides in the water. See also total dissolved solids.

salmonid fish species belonging to the salmon family, including salmon and trout.

schist a metamorphic rock that readily splits into thin flakes.

seepage the gradual movement of a fluid into, through, or from a porous medium.

septic tank lechate the fluid that leaves a septic tank and usually percolates down to the groundwater table or moves laterally until it is used by vegetation or empties into a stream or lake.

service area the geographic area served by a water agency.

slake the crumbling or disintegration of rock upon exposure to air or moisture.

soil-stratigraphic unit a soil with physical characteristics and relationship with other soils that permit its consistent recognition and mapping.

soluble minerals naturally occurring substances capable of being dissolved.

submarine fan a fan-shaped deposit on the sea floor that is seaward of large rivers or submarine canyons.

surface supply water supply from streams, lakes, and reservoirs.

syncline a fold in sedimentary rocks that is concave upward.

T

tectonic boundary a boundary between two or more areas of similar faulting and folding.

tectonic scarps a line of cliffs producing by faulting

tertiary a geologic period that covers the geologic time scale from 1.6 to about 65 million years ago.

threatened species a species at high risk to extinction in the wild in the medium term future.

total dissolved solids (TDS) a quantitative measure of the residual minerals dissolved in water that remain after evaporation of a solution. Usually expressed in milligrams per liter. Abbreviation: TDS. See also salinity.

tuff a general term for all rock that is formed by volcanic material transported into place by air or water.

U

unconformity a gap or break in the deposition between two rock units. During this break in deposition, the lower rock unit has been eroded or weathered.

unimpaired flow the flow past a specified point on a natural stream that is unaffected by stream diversion, storage, import, export, return flow, or change in use caused by modifications in land use.

V

vernal pools ephemeral wetlands forming in shallow depressions underlain by a substrate near the surface that restricts the percolation of water.

W

water gaps a deep pass in a mountain ridge, through which a stream flows.

water quality description of the chemical, physical, and biological characteristics of water, usually in regard to its suitability for a particular purpose or use.

water recycling the treatment of urban wastewater to a level rendering it suitable for a specific beneficial use.

watershed see drainage basin.

water table see groundwater table.

water transfers marketing arrangements that can include the permanent sale of a water right by the water right holder; a lease of the right to use water from the water right holder; the sale or lease of a contractual right to water supply.

well completion reports reports of water wells constructed in California. The reports contain data about the well and the materials encountered in its construction.

wetlands delineations investigation of inundated areas to determine if hydrology, soils, and vegetation qualify the area to be subject to jurisdictional regulation.

State of California, Gray Davis, Governor
The Resources Agency, Mary D. Nichols, Secretary for Resources
Department of Water Resources, Thomas M. Hannigan, Director

Steve Macaulay, Chief Deputy Director
Jonas Minton, Deputy Director
L. Lucinda Chipponeri, Assistant Director for Legislation
Susan N. Weber, Chief Counsel

William J. Bennett, Chief, Division of Planning and Local Assistance

This report was prepared under the direction of
Naser J. Bateni, Chief, Integrated Storage Investigations

In coordination with CALFED

by
Charlie Brown, Department of Fish and Game
Brad Burkholder, Department of Fish and Game
Jenny Marr*, Department of Fish and Game
Frank Wernette, Department of Fish and Game

David J. Bogener, Department of Water Resources
Gerald Boles, Department of Water Resources
Koll Buer, Department of Water Resources
Doug Denton, Department of Water Resources
K. Glyn Echols, Department of Water Resources
Gary Hester, Department of Water Resources
Ralph Hinton, Department of Water Resources
Gail Kuenster, Department of Water Resources
Joyce Lacey-Rickert, Department of Water Resources
Glen Pearson, Department of Water Resources
Doug Rischbieter, Department of Water Resources
Jim Wieking, Department of Water Resources
Waiman Yip, Department of Water Resources

Robert Orlins, Department of Parks and Recreation

assisted by
Nikki Blomquist, Department of Water Resources
Linton Brown, Department of Water Resources
Elle Burns, Department of Water Resources
Barbara Castro, Department of Water Resources
Julia Culp, Department of Water Resources
Jennifer Davis-Ferris, Department of Water Resources
Mark Dombrowski, Department of Water Resources
Lawrence Janeway, Department of Water Resources
Liz Kanter, Department of Water Resources
Sandy Merritt, Department of Water Resources
Shawn Pike, Department of Water Resources
Carole Rains, Department of Water Resources
April Scholzen, Department of Water Resources
Michael Serna, Department of Water Resources
Ward Tabor, Department of Water Resources
Marilee Talley, Department of Water Resources
Susan Tatayon, Department of Water Resources
Caroline Warren, Department of Water Resources

Special thanks to DWR's Northern District staff,
who drafted many chapters of this progress report and conducted many of the studies that form its core.

State of California
The Resources Agency
Department of Water Resources
Division of Planning and Local Assistance